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## INTRODUCTION

Around here it's all about gadget guts. With VR becoming all the rage, we couldn't wait for a little Vive-section. What does HTC have hiding right before your eyes? Strap a black box to your head, 'cause we're about to find out! It's time to tear down the Vive.

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[video: <https://www.youtube.com/watch?v=uj4TzSo6kQM>]

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### TOOLS:

- [Spudger](#) (1)
  - [Tweezers](#) (1)
  - [iFixit Opening Picks set of 6](#) (1)
  - [T4 Torx Screwdriver](#) (1)
  - [T5 Torx Screwdriver](#) (1)
  - [T6 Torx Screwdriver](#) (1)
  - [T7 Torx Screwdriver](#) (1)
  - [Phillips #0 Screwdriver](#) (1)
  - [Phillips #00 Screwdriver](#) (1)
  - [iOpener](#) (1)
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## Step 1 — HTC Vive Teardown



- It's been a long time coming, but 2016 seems to be the year when virtual reality finally becomes an *actual* reality. How does it work? Well, here are the specs:
  - Two 1080p AMOLED displays with a combined resolution of 2160 x 1200
  - 90 Hz refresh rate
  - Built-in front-facing camera and microphone
  - Accelerometer, gyroscope, and laser position sensor
  - 360-degree headset tracking via Lighthouse IR emitters
  - 110° horizontal field of view
- ① This all compares pretty favorably—or in some cases, identically—with the [Oculus Rift CV1](#) we tore down a few weeks ago.

## Step 2



- After unplugging ourselves from the Matrix the four headset cables, we spy the headset's model number: 0PJT100.
- We also spot a standard 3.5 mm audio jack, DC barrel jack, and a single HDMI port flanked by two USB 3.0 ports.
  - ❗ Interestingly, HTC left the rightmost USB port open for third-party accessories.
- Bottoms up! We flip the Vive and go eye-to-eye with the front-facing camera. This unblinking cyclops also provides AR for the Vive. What's it running on? Let's get inside and find out.

## Step 3



- First to go is the interchangeable foam insert, velcroed to the headset for our convenience.
- We peel back the velcro to reveal a hidden message.  
⚠ Who're you callin' [wide face](#)? Huh?
- Nestled in a nook between the eyepieces is a proximity sensor that detects when the Vive is actually on your face—presumably to shut off the displays, conserving power and processor resources.

## Step 4



- Cog-zooks! We've got our gears turning as we remove the [eye relief](#) adjustment on the Vive headset.
  - ⓘ Not to be confused with [IPD](#), this adjustment actually controls the distance from the headset's optics to your eyes.
- The Rift CV1 doesn't have this feature, probably because its [asymmetric lenses](#) allow you to adjust focus by simply pushing the headset higher or lower on your face. Is this confirmation of a different approach to optics in the Vive? Only more teardown will tell.

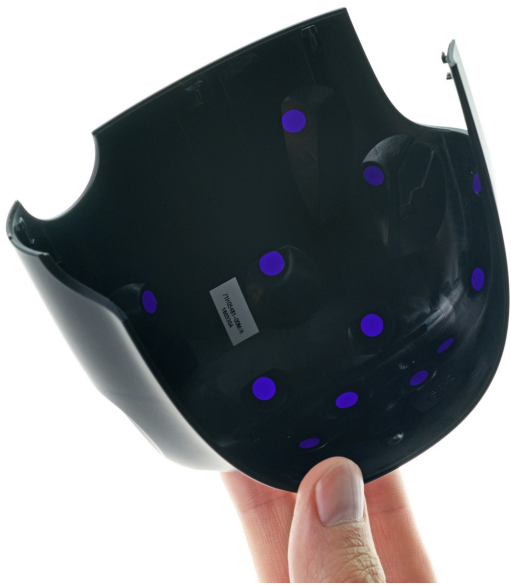


## Step 5



- We can't help but experience a little [\*déjà vu\*](#) as we unmask our latest subject.
- Pulling back the outer shell on the Vive reveals a number of sensors—32 in total, according to HTC.
- These photodiodes take in IR light from the two Lighthouse base stations as they flash and sweep light across the room. This enables a connected PC to [calculate the headset's position](#) and orientation in space as a function of the time between receiving the flash and the following IR laser sweep.
- ① This method is the exact opposite of the head-tracking technique found in the Oculus Rift. In the Rift, the desk-mounted camera tracked the IR emitters in the headset, whereas in the Vive, the headset sees light from the mounted IR emitters without actually "tracking" its location.

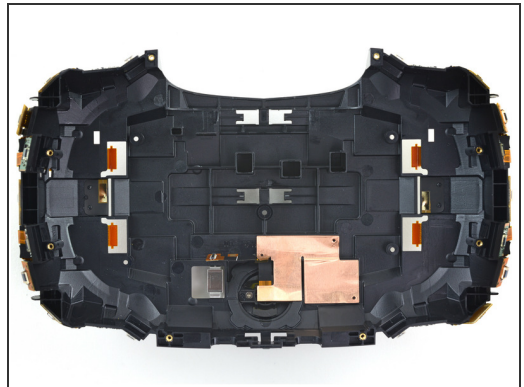
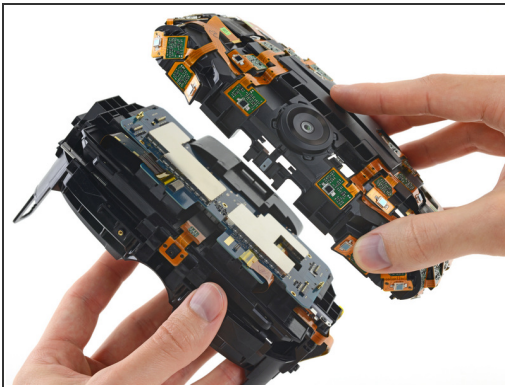
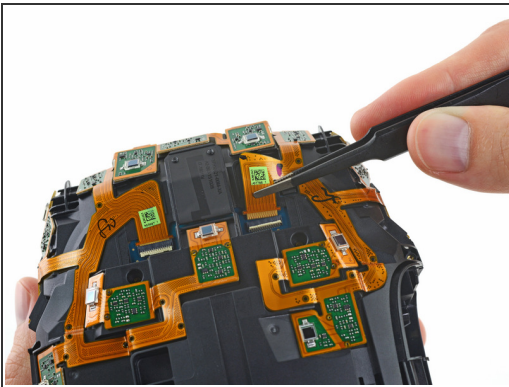
## Step 6



- A closer look at the outer shell reveals that each divot on the surface holds a small IR filter.
- These IR windows give the photodiodes beneath a clear view of the lights and lasers emitted from the Lighthouse base stations.

★ More on those later.

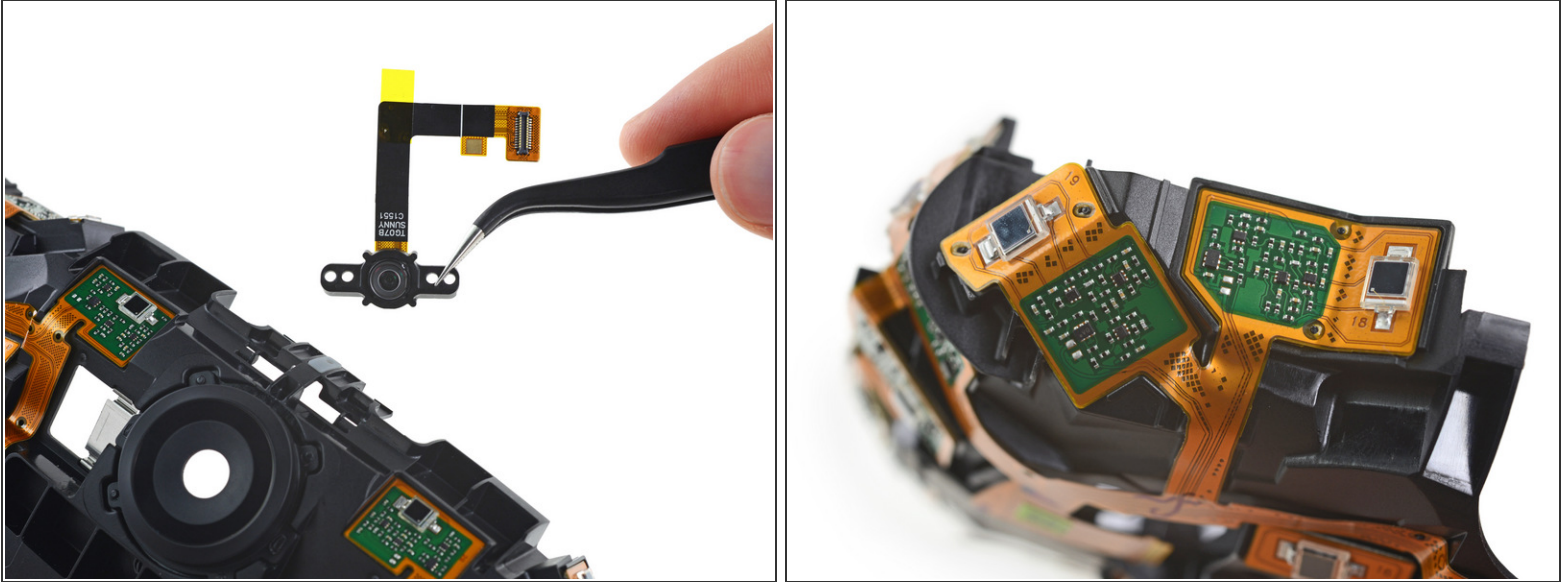
## Step 7



- With the outer sheath removed, we flip the switch on a few ZIF connectors to disconnect the IR photodiode webbing from the motherboard.
- ★ For those of you keeping score, everything thus far has been super standard and easy to take apart. It seems that this apple fell especially far from the [tape-and-glue](#) tree.
- After deftly dispatching a hidden press connector behind the front-facing camera, the whole sensor array lifts off. Easy peasy.
- Hiding in the back of the assembly, we find a couple spring contacts that deliver power to the whole setup—and behind that swath of copper tape, the camera.

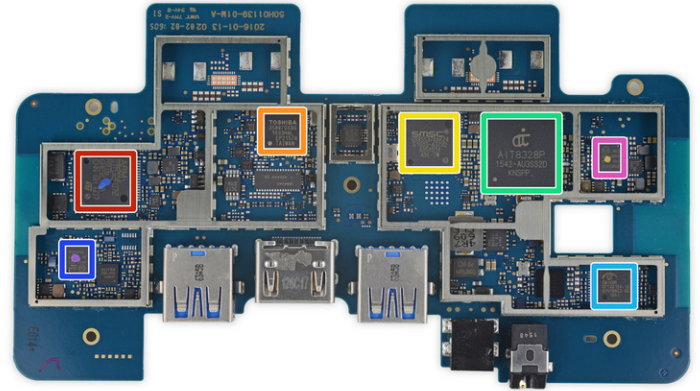
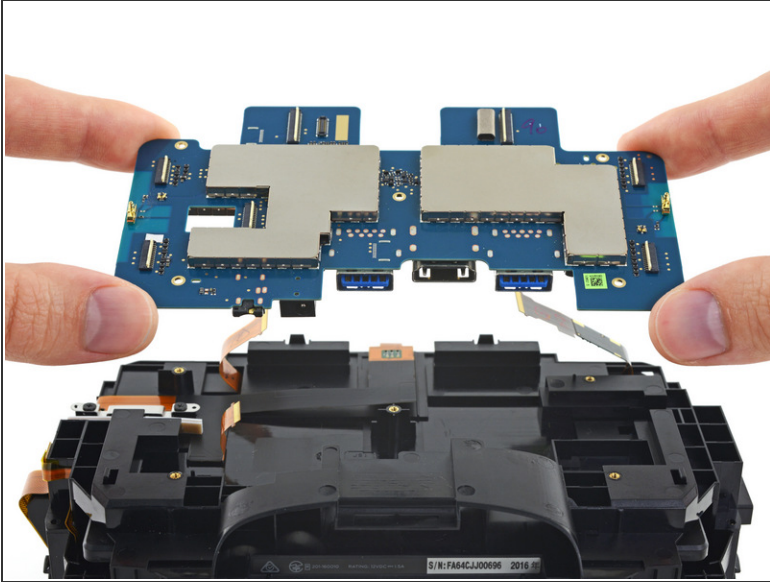


## Step 8



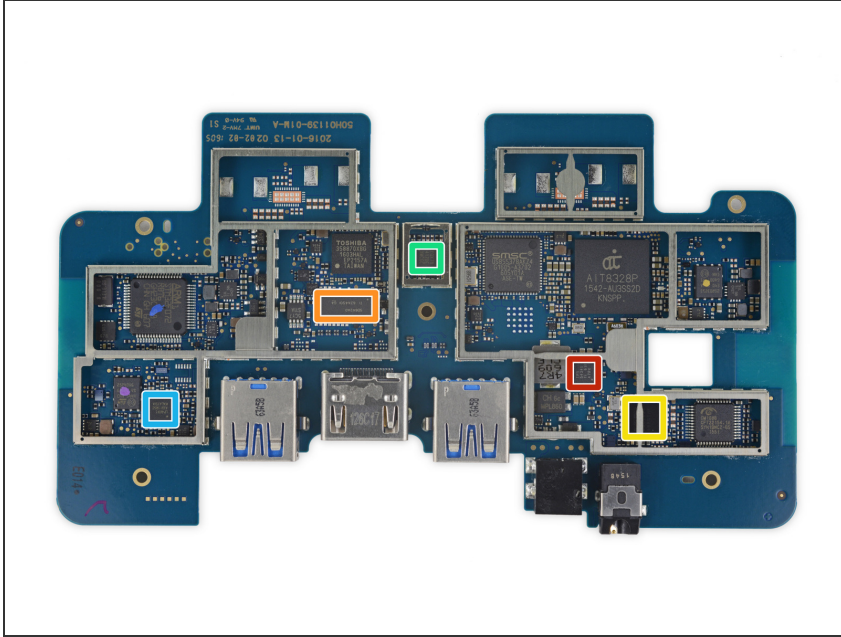
- With tweezers in hand, we pluck the front-facing camera out of the Vive. Manufactured by Sunny Optical Technology, it reads: TG07B C1551
  - ⓘ That name might sound familiar. We've also seen Sunny camera modules in the [OnePlus One](#) and [Project Tango](#) phones.
- Working our way around the sensor net, we note that each of the sensors is individually numbered (photodiodes 18 and 19 in the photo).

## Step 9

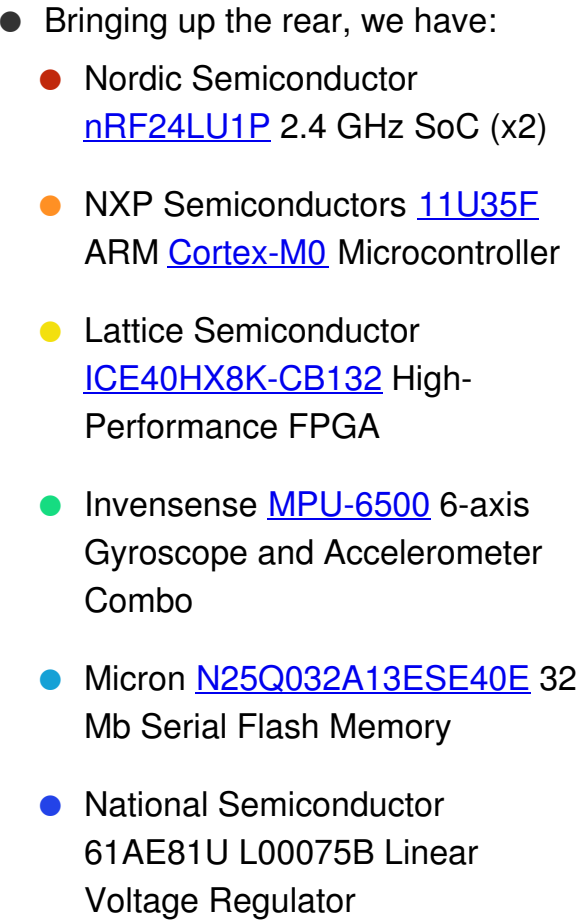


- We have liftoff—of the motherboard, that is. Let's see what sort of silicon is lurking beneath those huge heat EMI shields. On the front side of the board:
  - STMicroelectronics [32F072R8](#) ARM [Cortex-M0](#) Microcontroller
  - Toshiba [TC358870XBG](#) 4K HDMI to MIPI Dual-DSI Converter (Also found in Oculus Rift CV1)
  - SMSC [USB5537B](#) 7-Port USB Hub Controller
  - Alpha Imaging Technology [AIT8328](#) SoC With Image Signal Processor
  - Cmedia [CM108B](#) USB Audio SoC
  - Micron [M25P40](#) 4 Mb Serial Flash Memory
  - Micron [N25Q032A13ESE40E](#) 32 Mb Serial Flash Memory

## Step 10



- Even more chips on the front:
  - Texas Instruments [TPS54341](#) Buck Converter
  - Texas Instruments [TS3DV642](#) 12-Channel Bi-Directional Multiplexer/Demultiplexer
  - Cirrus Logic [WM5102](#) Audio Codec
  - Pericom Semiconductor [PI3EQX7841](#) USB 3.0 Repeater
  - Lattice Semiconductor [LP4K81 A3311RG2](#) Ultra-low Power FPGA



## Step 12



- Next out: the midframe that housed the motherboard. Clinging to its side we find a small ribbon cable that plays host to the headset button.
- A closer look at the midframe reveals a slot for the little black nub on the back of the left display panel.
  - ⓘ This slot allows the nub to peek through and slide along that white Teflon strip, activating a linear [potentiometer](#), used to track IPD position as you adjust the displays.
- Ready to go deeper, we remove the twin lens-and-display assemblies from their housing and peel off the rubber light-gasket from around the lenses.



## Step 13



- [Open! Close! Open! Close!](#)
  - Speaking of [interpupillary distance](#) adjustment, here's the mechanism that makes that possible.
  - It's a simple threaded rod with a slider at the top. It couldn't be simpler, really—just give it a twist.
- ① We saw something similar on the Oculus Rift CV1—although the Rift packs a more sophisticated (and more complicated) [dual rack-and-pinion system](#).

## Step 14



- After *adios-ing* four Phillips screws and doing a little investigative prying, we lift away the display cover for access to one of the twin Samsung-branded AMOLED panels.
- Each display measures ~91.8 mm diagonally, which translates to ~447 ppi. For comparison, the Rift CV1 has ~456 ppi due to a slightly smaller display (90 mm) that still packs the same resolution as the Vive.

## Step 15



- A bit of adhesive secures each lens, but it doesn't take much to pop them out.
- We note a set of concentric rings in each lens—the [familiar](#) indicator of Fresnel lenses.
- ❗ Unlike the [hybrid lenses](#) we encountered in the Oculus Rift, the Vive's lenses *appear* to have a uniform contour. It seems that HTC opted to control focus through adjustment of the eye relief.
- Etched right into the side of the lens, we find the smallest QR code we've ever seen. Despite our best efforts, we can't get it to scan.
- ❗ Maybe we just need a [smaller phone](#).

## Step 16



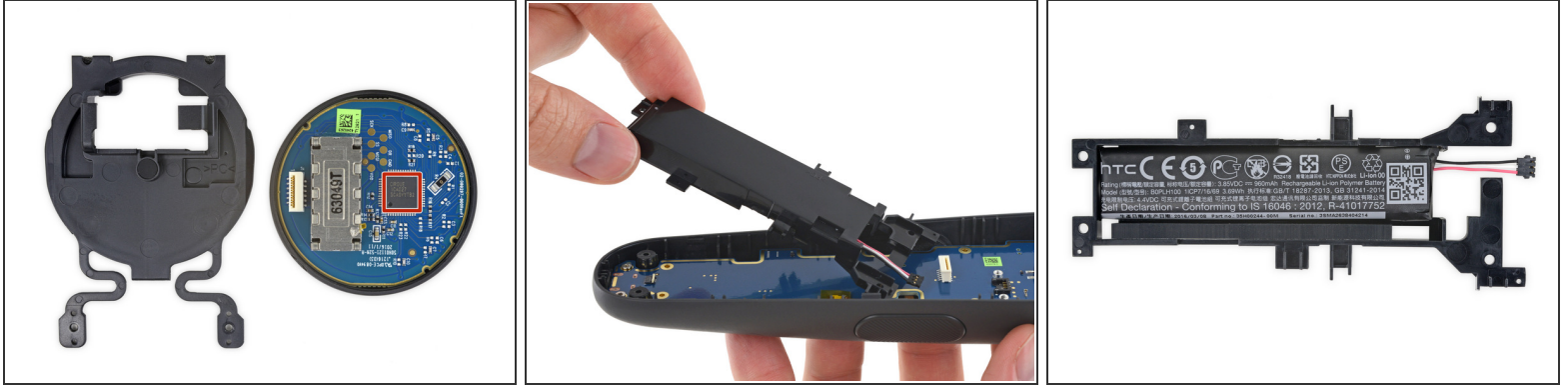
- With the headset completely disassembled, it's time to move on to the controller. A quick inspection reveals the model number: 2PR7100.
- The Vive is manufactured by HTC, but it's quite evident that Valve had plenty of input on the design process. The controller touchpad is *very* reminiscent of the ones we found on the [Steam Controller](#).
- In addition to the touchpad and buttons, the controller comes packed with 24 sensors (including two *inside* the ring!) that allow it to accurately track the its position based on the two Lighthouse base stations.

## Step 17



- A few Torx screws and some tough plastic clips keep the outer case and IR filters shut tight, but it's nothing we can't *handle*.
- As we work our way down the controller, we find a ribbon cable booby trap, à la [iPhone 5s](#) and [iPhone SE](#).
- Trap defused, we pop open the handle and take a closer look.

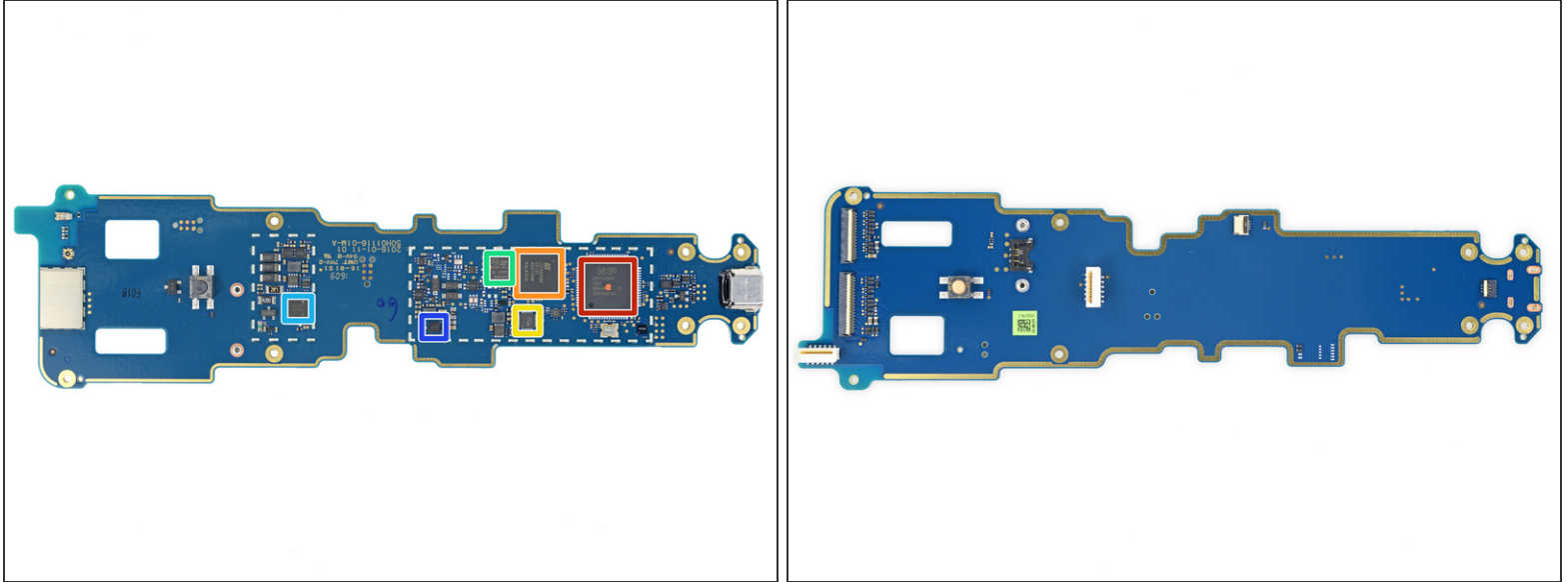
## Step 18



- After removing the touchpad assembly from the controller, we immediately notice that the daughterboard is near-identical to the one found in the Steam Controller.
  - Just like before, the touchpad is driven by a Cirque [1CA027](#) companion MCU.
- As with the Steam Controller, the PCB also features seven well-labeled test points that make it easy to directly interface with the board for testing.
- Up next is the 3.85 V, 3.69 Whr, and 960 mAh Li-poly battery. After giving it a good looksee, we spot the model number B0PLH100, and a large QR code.
  - ❗ Unfortunately, scanning the QR code doesn't reveal a secret message, just the serial number: 3SMA2638404214.
- Amazing! [We've got that same combination on our luggage.](#)

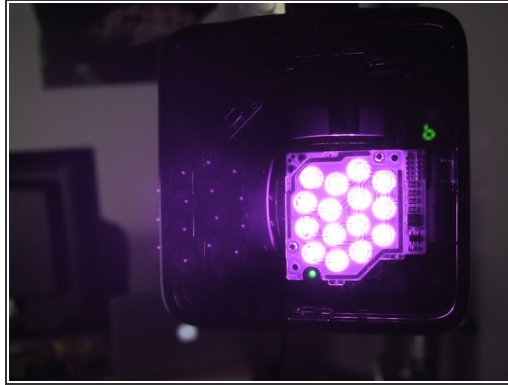


## Step 19



- There are a few common chips between the controller and the headset, as well as a few new ones:
  - NXP Semiconductors [11U37F](#) ARM [Cortex-M0](#) Microcontroller
  - Lattice Semiconductor [ICE40HX8K-CB132](#) Ultra-low Power FPGA
  - Invensense [MPU-6500](#) 6-axis Gyroscope and Accelerometer Combo
  - Micron [M25P40](#) 4 Mb Serial Flash Memory
  - National Semiconductor 61AKE6U L00075B Linear Voltage Regulator
  - TI [BQ24158](#) Battery Charger IC

## Step 20



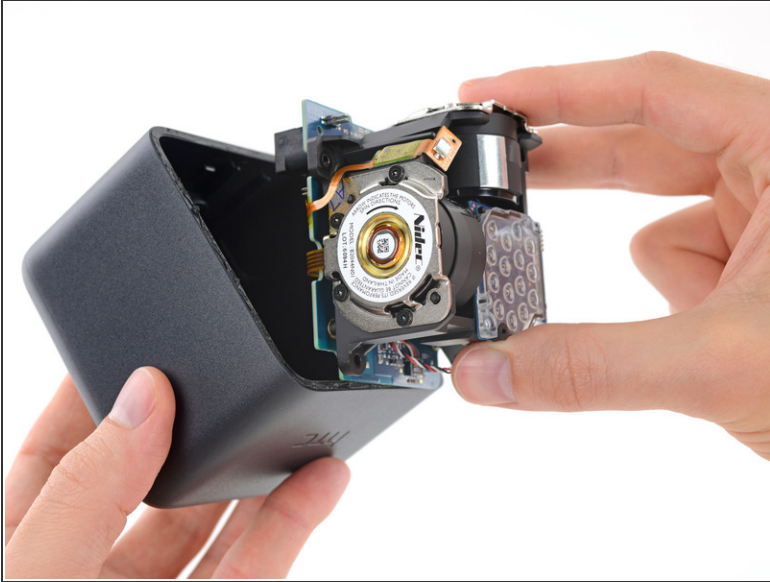
- With the headset and controllers torn asunder, we move right along to one of the Lighthouse base stations. What secrets does it hold? Let's find out!
- Firing up our IR camera, we get a glimpse of the internals through the IR-transparent front panel—an array of bright IR LEDs, and a pair of motorized lasers make the Lighthouse [shine bright](#).
- ⓘ While the Rift works with an IR camera and some fancy machine vision software to follow the [Constellation IR LED](#) array, the Vive uses an entirely different [system for position tracking](#).
- Each Lighthouse flashes its IR LED array, signaling the start of a cycle. Vertical and horizontal lasers then sweep across the room, and all of those fancy photosensors on the headset and controllers start looking for lasers.
- The tracked headset or controller can then determine its position based on the order its sensors receive the laser sweeps.

## Step 21



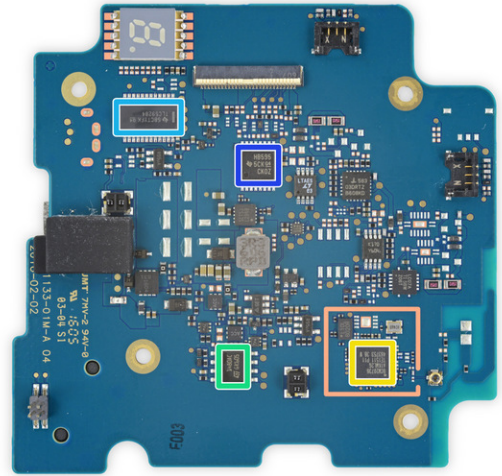
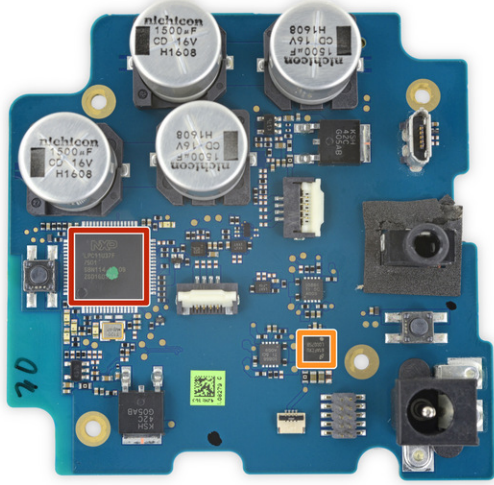
- Time to crack the Lighthouse open and check how the system matches our science.
- The base station sports the model number [2PR8100](#) as well as a Class 1 Laser Product regulatory label.
  - ⓘ This rating means that the IR lasers contained inside the base station are within the maximum permissible exposure rating established by the [CDRH](#). In other words, the lasers can be shined on the eye or skin with a negligible chance of damage.
- With a trusty iOpener and opening pick in hand, we quickly dispatch a few clips and some sticky gasketing that secure the base station's front panel.

## Step 22



- The front panel removed with relative ease, we prepare for the harrowing task of extracting the complex internals from this optical tech marvel.
- Aaaand we're done. Lucky for us, the whole unit is installed as a single assembly within the Lighthouse base station housing. Just remove the four Torx screws, and it falls right out.
- With the cover off, we get a look at the array of IR LEDs and spinning motor-mounted laser emitters, as well as a single IR photodiode that allows the device to sync up with its counterpart.

## Step 23



- Let's shed some light on what sort of chips are powering the Lighthouse:
  - NXP Semiconductors [11U37F](#) ARM Cortex-M0 Microcontroller
  - National Semiconductor 61AFCXU L00075B Linear Voltage Regulator
  - Broadcom [BCM20736](#) Bluetooth Smart SoC
  - STMicroelectronics [ST1480AC](#) Transceiver
  - Texas Instruments [TLC59284](#) 16-Channel LED Driver
  - Texas Instruments [SN74AHCT595DBR](#) 8-Bit Shift Register With 3-State Output Register





- All of our repair wishes are coming true today! Each laser motor mounts to the Lighthouse emitter assembly via four T5 Torx screws, and connects to the motherboard with a single ZIF connector.
- [Nidec](#) may not be a household name, but we've seen their DC motors before powering fans in the [Xbox One Kinect](#), as well as the [Mac Pro Late 2013](#). These particular motors read: B2044N01.
- With the Lighthouse parts laid out for inspection, this teardown is adjourned.

## Step 25



- The HTC Vive Repairability Score: **8 out of 10** (10 is best):
  - Although it's a complicated bit of kit, the headset breaks down readily and without damage.
  - The head strap and face pads are removable and don't incorporate any sensors or electronics that might be prone to failure.
  - Standard Phillips and Torx screws are used throughout the headset, controllers, and base stations.
  - Reuse of the touchpad hardware from the Steam Controller means some replacement components are likely already available.
  - The large number of components, many of them quite delicate, means you'll want a service manual before attempting repairs.
  - Adhesive is used sparingly, but secures the lenses, Lighthouse base station covers, and sensor arrays.

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